

Appl. No. 10/743,985
Amdt. dated 04/18/2008
Response to Office Action of 02/26/2008

Attorney Docket No.: N1085-00168
[TSMC 2003-0219]

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REMARKS/ARGUMENTS

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Claims 11-19 and 36-46 were previously pending in this application with claims 36-46 having been previously withdrawn from consideration. As such, claims 11-19 are being prosecuted and should have been examined on the merits. The Office action
5 Summary sheet indicates that claims "11, 12 and 14-19" were rejected and includes claim 13 as being a withdrawn claim. Claim 13 was included in Species 1 identified by the Examiner in the previous Office action – a restriction requirement – dated 10/31/2007. Responsive to said restriction requirement, Applicants responded on November 30, 2007 and elected species 1, claims 11-19.

10 In a telephone message left with Applicants' undersigned representative, Mark J. Marcelli, on April 14, 2008, Examiner Schillinger indicated that the October 31, 2007 Restriction Requirement was in error and that the Examiner intended to include claim 13 in Species II and that claim 13 subsequently was withdrawn by the Examiner sua sponte.

15 I. **Claim Rejections – 35 U.S.C. § 103**

On page 3 of the subject Office action, claims 11-12, 14-19 were rejected under 35 U.S.C. § 103(a) as being unpatentable over King et al., "Sub-5 um Multiple-Thickness Gate Oxide Technology Using Oxygen Implantation", Int. Electron Device Meeting (IEDM), San Francisco, Paper 21.1.1 (1998), hereinafter "King". Applicants
20 respectfully submit that these claim rejections are overcome for reason set forth below.

Claim 11 is the independent claim among claims 11-19. Claim 11 recites the features of:

25 oxygen ions providing discrete implant regions in a substrate of an SOI device, the discrete implant regions extending to a surface of the substrate; and

a gate oxide layer covering but not encroaching the discrete implant regions and being under the one or more additional gate regions.

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As pointed out in Applicants' previous responses, King does not teach a gate oxide layer covering but not encroaching the discrete implant regions. Rather, the gate oxide in King absolutely encroaches the oxygen implant area because the gate oxide is a thermal oxide layer grown on an oxygen-implanted silicon substrate and therefore necessarily at the expense of the oxygen-implanted silicon substrate and therefore encroaching the oxygen-implanted silicon substrate. This is true for at least two reasons:

1) King teaches and illustrates this "encroaching" aspect; and

2) King's oxide is a thermally grown oxide and one of ordinary skill in the art recognizes that any thermal oxide necessarily encroaches the surface on which it is grown.

As a first matter, the King article starts out with the **Abstract** providing the following: "A novel and simple method of growing oxides of multiple thicknesses using oxygen implant . . .". Further, under the title **Introduction**, second paragraph, King provides "We propose a new method of growing multiple gate oxide thicknesses using an oxygen implant to increase the oxide thickness . . .". In referring to the Breakdown Voltage chart of Fig. 5, King provides: "this result suggests that the gate oxides grown with oxygen implantation . . .". (col. 3, lines 3-5). Importantly, in column 2, lines 2-3, King provides "gate oxidation at 800°C."

It is therefore uncontroverted that the gate oxide of King is a thermally grown oxide.

It is equally uncontroverted that one of ordinary skill in the art knows that thermally grown oxides grow by ambient oxygen reacting with and thereby encroaching an exposed surface that includes a material with which the oxygen reacts to form the oxide. For example, ambient oxygen penetrates and combines with a silicon surface to form an oxygen compound, i.e., silicon dioxide.

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In the section titled "Response to Arguments", the Office action contends that "Fig. 1(a) does not depict encroaching – the figure depicts depositing a thermal oxidation layer on top of the implanted oxide regions". Applicants respectfully submit that this is absolutely not true. The figure does not depict depositing a thermal oxidation
5 layer because "thermal oxide layers" are not "deposited"; rather, they are "grown". A thermal oxidation layer is formed by a heating operation with an oxygen ambient to grow an oxide on a surface and therefore a thermal oxide cannot be "deposited".

As such, the figure certainly does not depict depositing a thermal oxide, but, rather, a thermally-grown oxide. Rather, the thermal oxide is grown and this is what the
10 figure depicts. Referring to Fig. 1(a), the top figure, and the first one in the processing sequence, depicts a substrate with a sacrificial oxide layer undergoing an O⁺ implant. After the O⁺ implant, the middle figure of Fig. 1(a), and the second one in the processing sequence, reveals the O⁺-implanted area in the silicon of the substrate on the left-hand side of the structure only, i.e. the portion that was not masked using the PR illustrated in
15 the top figure. Between the second and third (bottom illustration in Fig. 1(a)) processing steps, the following occurs as also illustrated in the figure: "*Cleaning, grow thin oxide, anneal*". As a result of the growing, the oxide illustrated in the bottom figure is produced. The gate oxide layer illustrated in the bottom Fig. 1(a) illustration, is defined by an upper and lower line to delineate the portion of the substrate that has been
20 converted to a thermal gate oxide layer at the expense of the implanted substrate.

The reason that the oxides have two different thicknesses in the two different regions, i.e. T_{ox2} is greater than T_{ox1}, is because they are both grown in one operation and the thermal oxide grows faster in the O⁺ implanted silicon substrate than in the non-implanted section of the same substrate. Indeed, it is clear from reading King that this
25 is a salient aspect of the article. The abstract states the "method of growing oxides of multiple thicknesses using oxygen implant." The Introduction provides "implanting nitrogen into the Si substrate before gate oxidation can form multiple gate oxide thicknesses by reducing the thermal oxidation rate at the implanted region". Hence, the

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use of different thermal oxidation RATES of implanted areas is an aspect of King. The Introduction then continues on and indicates that "we propose a new method of growing multiple gate oxide thicknesses using an oxygen implant", clearly applying the different thermal oxidation rate principle to O⁺ implanted silicon. Even though the King reference
5 does not explicitly state that the multiple gate oxide thicknesses are produced by different thermal oxidation rates in oxygen implanted areas versus non-oxygen implanted areas, such is inherent because of the above discussion.

Finally, it is clear that the gate oxidation process is a thermal one and not a deposition, because nowhere in King do the terms "deposition" or "deposit" appear.

10 The Office action also concedes that the gate oxide is carried out by a thermal oxidation process on page 6, lines 11-13: "Furthermore, in the New Technology section of King – King explicitly teaches to carry out thermal oxidation in addition to implanting in order to form an additional gate oxide layer". With respect to the expression "additional gate oxide" Applicants point out that there is only one gate oxide layer on
15 any substrate region and the O⁺ implanted area is not an oxide layer; rather, it is simply an O⁺ implanted portion of the substrate, separated from the oxide layer by the line representing the border therebetween.

Since the thermal gate oxidation grown at 800°C necessarily grows at the expense of the silicon substrate and necessarily encroaches the O⁺-implanted substrate
20 region, King clearly does not provide the feature of a gate oxide layer covering but not encroaching the discrete implant regions as in claim 11. Claim 11 is therefore distinguished from King. Claims 12-19 are similarly distinguished from King by virtue of their respective dependencies from claim 11.

The Office action also mentioned the Sakaguchi reference, USP 5,492,859 for
25 teaching an SOI substrate but Sakaguchi does not make up for the above-stated deficiencies of King. Claims 11-19 are therefore distinguished from King and Sakaguchi, taken alone or in combination.

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Therefore, the rejection of claims 11, 12 and 14-19 should be withdrawn.
Moreover, claim 13 should be rejoined and allowed as being dependent upon claim 11
which is in allowable form.

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CONCLUSION

Based on the foregoing, each of pending claims 11-19 is in allowable form and the application in condition for allowance, which action is respectfully and expeditiously requested.

5 The Assistant Commissioner for Patents is hereby authorized to charge any fees necessary to give effect to this filing and to credit any excess payment that may be associated with this communication, to Deposit Account 04-1679.

Respectfully submitted,

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Dated: 18 April 2008


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